CHAPTER I

INTRODUCTION

1.1 Background

A high quality suspension system should have capability to reduce the car body displacement and acceleration, and maintain in the right contact between tire and road surface (Alleyne and Hendrick, 1995). The suspensions can be passive, semi-active and active systems. Nowadays, the active suspension is the key technology for vehicles to achieve both ride comfort and road handling performances. In the last decade, this issues has became an interesting topic and developed by many researchers in the laboratory. All research that occurred to achieve and improve the performance and capability of the suspension system is carried out in a test rig form. By using the test rig, any model of controllers can be applied to improve the performance of the system.

Figure 1.1 Test rig for a quarter car active suspension system

Test rig is a representation of the actual system which is designed to test, analyze, develop and control the performance of the system as shown in figure 1.1.

Test rig for a quarter car active suspension systems is representation of the actual suspension system which the single wheel and axle are connected to the quarter portion of the car body and considered to vertical motion only (Sam *et al.*, 2004). Usually the quarter car can be front left or front right of the car suspensions.

A quarter car active suspension includes a mass-spring-damper as passive components and servo-hydraulic actuator as active component, while the tire is modeled as a simple spring without damping as can be seen in Figure 1.2. In the laboratory, a quarter car suspension systems are represented as a test rig which is used to measure and achieve the performance of the active suspension systems.

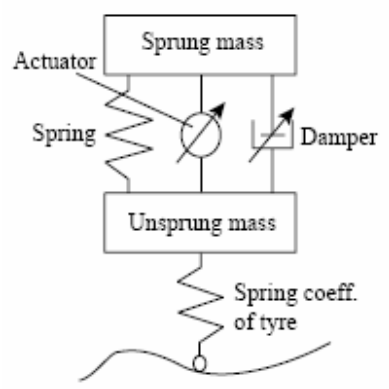

Figure 1.2. Active Suspension System

In developed a test rig of a quarter car active suspension system, the components parameters of damper, spring and servo are unknown. The components are damper, spring and servo hydraulic actuator. Those parameters are extremely important to analyze and control to achieve the desired performance. Furthermore, controller can not be designed if parameters of the system are unknown. Therefore, an appropriate technique that called system identification technique is applied to obtain those unknown parameters.

There are various system identification techniques such as Linear Auto-Correlation Exogenous (ARX) Model, Back Propagation Neural Network (BP-NN), On-line Recursive Least Squares (RLS), Recurrent Neural Network, etc, have been applied in previous research to identify and estimate the model and parameters of the spring and damper, and also the servo hydraulic actuator. In this study, system identification technique is deal with Least Squares (LS) method which is utilized to identify the unknown parameters of the systems.

1.2 Problem Statement

It is necessary to know the constant parameters of the passive components such as damper and spring, and also estimate model of the hydraulic actuator, for a new design of test rig for a quarter car active suspension systems.

1.3 Objectives of Project

a. To determine the model and parameters of the passive components (damper and spring) for a quarter car active suspension systems.
b. To determine the model of servo-hydraulic for a quarter car active suspension systems.

1.4 Scope of Project

The scope of this project are estimating the model and parameters of the passive system (spring constant, ks and damper coefficient, bs), and model of servo hydraulic actuator of test rig for a quarter car active suspension system using System Identification techniques based on experiment and computational works.

1.5 Significance of Project

By using system identification technique the parameters of the active suspension systems can be obtained and those parameters will be used to control and achieve the performance of the system.

1.6 Thesis Outline

This thesis consists of six chapters. It begins with the introductory chapter. This chapter gives the brief description of the problem statement and background of the test rig for a quarter car suspension systems, objectives, scope and significance of the project.

Chapter two discusses the literature review and others related works from previous existing modeling paradigm and technique to identify and estimate the parameters of the test rig for a quarter car active suspension system.

Chapter three includes design and methodology of the study. It contains design of the system, experimental design and procedure, and system identification process.

Chapter four is experimental set-up for both systems passive and hydraulic actuator respectively.

Chapter five is results and discussion of the study for both of the systems, the passive system and hydraulic actuator.

Then, chapter six describes conclusion and suggestion of the thesis.